OTTERPOOL PARK

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APPLICATION DOCUMENT | **3.14**

MINERALS ASSESSMENT

ARCADIS

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Author: SLR

February 2019

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MINERAL RESOURCE ASSESSMENT

Otterpool Park

Prepared for: Arcadis Consulting (UK) Ltd

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1.0 Introduction

1.1 General

Arcadis Consulting (UK) Ltd (Arcadis) has instructed SLR Consulting Ltd (SLR) to undertake an assessment of the mineral resources within an area for proposed development at Otterpool Park, near Folkestone.

1.2 Scope

The scope of works for the Mineral Resource Assessment for the site is as follows:

- Review of site setting including land use history, hydrogeology, hydrology and cultural heritage. Relevant details will be included in the report including potential constraints to extraction.
- Geology – details of the type-occurrence of each of the four minerals within the safeguarding area. This will include review of available BGS information, data from the Arcadis ground investigation (whilst limited this would provide a line of evidence of ground conditions / minerals present). Where possible obtain historic information about quarries in the area (this information will be requested from Folkestone & Hythe District Council / Kent CC).
- Comment on the general quality requirements and potential quality of the mineral in relation to value as a construction material or constituent in manufactured materials (i.e. ready-mixed concrete, asphalt, bricks etc) and the relative scarcity of minerals with the Otterpool site and wider Kent area.
- Review relevant policies in NPPF, KCC and FH DC and guidance within the 'Safeguarding Supplementary Planning Document' (KCC, 2017) and 'Minerals Safeguarding in England: Good Practice Advice' (British Geological Survey, 2011. Provide comment on how they relate to the site.
- Provide high level review concerning logistics of extracting i.e. comment on access / topography / ground conditions including groundwater / noise / air quality / dust, and the form of voids created and reinstatement.
- A general discussion about whether extraction appears feasible in relation to access, topography, strata dip and resultant mineral depths, overburden to winnable deposit thickness. Depth to groundwater in relation to mineral depth would form a core part of this phase of the study.
- Apply the above lines of evidence to estimate potential areas / volumes of each mineral, inclusive of when appropriate buffers are applied. The buffers are distances applied from existing features as extraction can't go directly up to them e.g. 100m buffer from existing residential properties / 10m from roads. This restricts the volume that could be extracted.
- Potential for on-site use and whether it is feasible and viable to extract the mineral resource ahead of development (or to partially extract it) to prevent unnecessary sterilisation.
- Draw conclusions based on information presented above. We will provide a qualitative perspective on each mineral resource, indicating whether extraction is favourable/unfavourable, based on the volumes calculated the likely quality or uncertainty thereof, and other constraints identified.

1.3 Methodology

A desk study of the geology and mineral resource potential has been undertaken using information provided by the client and obtained from the public domain (see section 1.2.1) to identify areas of currently unsterilised mineral deposits within the area of the proposed development. Information sources relating to the extent of geological deposits, physical properties of the deposits, and the potential for extraction in respect of possible environmental impacts have been consulted to attempt to establish the amount of mineral potentially sterilised by the proposed development.

1.3.1 Data Sources

In the production of a desk-based Mineral Assessment it is necessary to consider all available relevant geological data for the site. Sources can include; information on the mining and quarrying history, mineral assessments and market appraisals, boreholes, site investigations, geological memoirs, technical reports, mining plans, and the thickness of superficial deposits.[1]

In the case of this assessment, the following data have been used to complete a desk study appraisal of the site:

- British Geological Survey (BGS)
  - GEOIndex Online resources - DigMap 1:50 000 mapping, borehole records, Lexicon of Name Rock Units
  - 1:50 000 geological map no. 305/306 Folkestone and Dover (solid and drift) & Memoir
  - Kent Mineral Resources 1: 100 000 scale map,
  - Mineral Resource Information for Development Plans Kent Report
  - BritPits Database
- Natural England
  - Environmental designations,
  - Special Protection Areas,
  - Special Areas of Conservation,
  - RAMSAR,
  - proposed RAMSAR,
  - SSSI units,
  - Ancient Woodland
- Historic England – listed buildings
- Environment Agency,
  - LIDAR topography,
  - source protection zones,
  - aquifer and aquifer vulnerability,
  - historic landfill records
- Google Earth- historic aerial photography
- Kent County Council
  - Adopted Policies Maps: Shepway District Mineral Safeguarding Areas,
  - Kent Minerals and Waste Local Plan Safeguarding Supplementary Planning Document,
  - Kent Minerals and Waste Local Plan

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1 Report: OR/11/046 Mineral safeguarding in England, good practice advice, British Geological Survey.

- Ordnance Survey – Open Map Raster tiles: T03SE,TR13SW,TR03NE, TR13NW
- Arcadis - Otterpool Park: Ground Investigation Factual Report (Dec 2017)
- Directory of Mines & Quarries (2014)

2.0 Development Site

2.1 Site Information

The site is located approximately 6km south east of Ashford, Kent, at approximate British National Grid reference TR 114 370. The site location is shown, edged in red in figure 1 below.

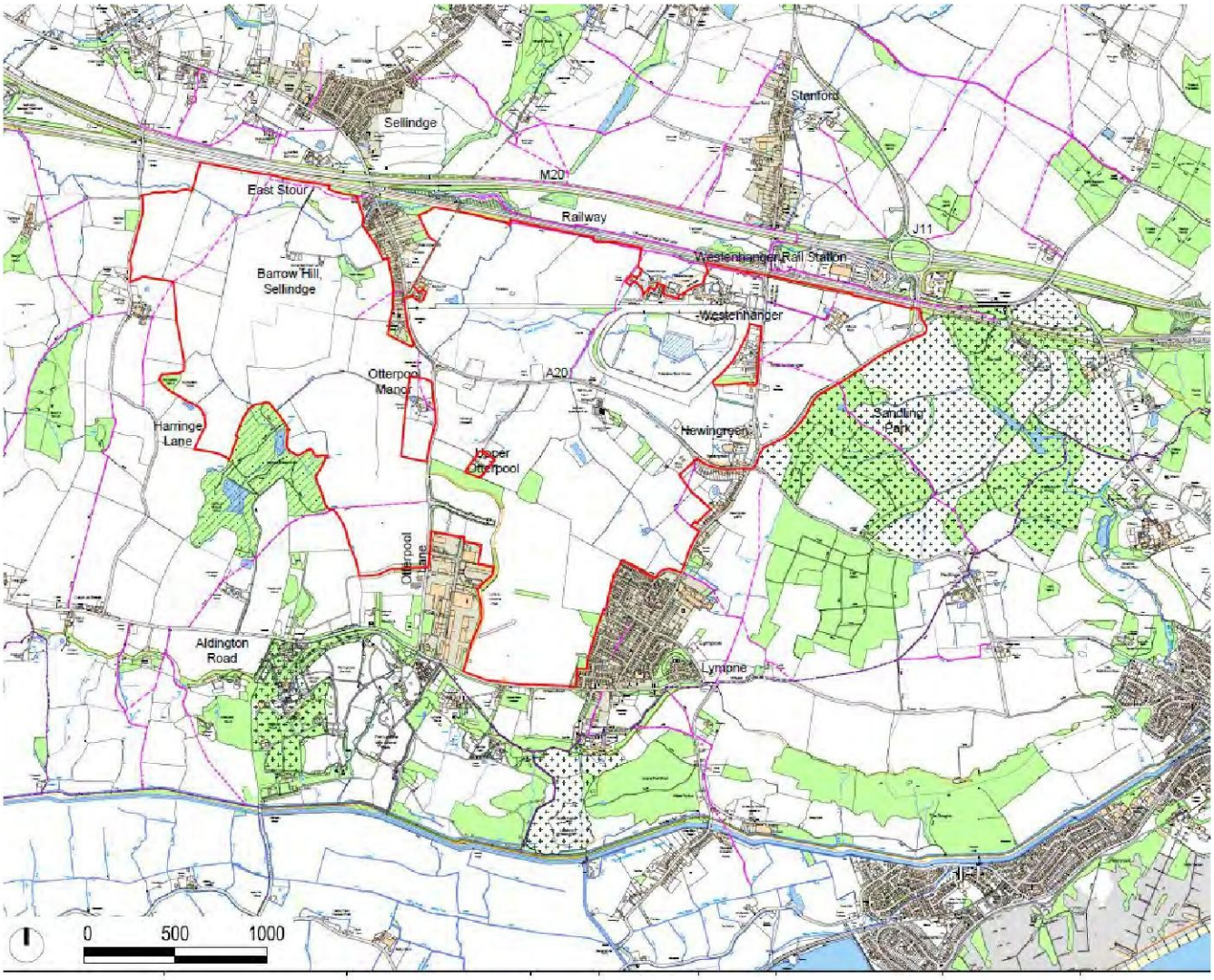

Figure 1 Site Location

The site covers approximately 580ha, which at the time of writing comprises arable and pasture fields, roads and trackways, and small clusters of buildings. The old Folkestone Racecourse is within the north east of the site.

The topography of the site slopes downwards towards the north, with elevations ranging from 100maOD in the north of the site to 65maOD in the north.

The site is bounded to the north by the M20 motorway and High Speed Rail 1 corridor, and bisected by the A20. To the south of the site is Lympne industrial estate which is located on the site of the former RAF Lympne airfield and the villages of Lympne, Newingreen and Westenhanger are found to the south east and east respectively.

Otterpool quarry is located near the centre of the site, directly south of the A20. The quarry is a former Kentish Ragstone extraction and processing site, which has historically been used for vehicle storage. Quarry activities appear to pre-date aerial photographic records from 1940, and quarrying operations ceased at the site between 2003 and 2006.

The East Stour River traverses the north of the site, and Ordnance Survey (OS) mapping indicates a network of drainage ditches. Numerous discrete ponds are found across the site.

Drawing 01 shows the site location with geographic features referred to within the report.

2.2 Proposed Development

The proposed Otterpool Park development comprises a 'garden town' style development, including residential, education, employment and leisure uses.

2.3 Historic Assets

A number of listed buildings are situated around the boundaries of the site, principally related to historic barns and houses in the villages and hamlets. Westenhanger Castle, to the north of the site, is a Scheduled Ancient Monument with associated listed buildings.

2.4 Environment Assets

The site contains the following environmental designated sites:

- Sites of Special Scientific Interest (SSSI): Otterpool Quarry – cited for geological exposures.

The site does not contain or fall within the following:

- Ancient woodland; although a number of areas exist adjacent to the site;
- RAMSAR;
- Special Protection Area;
- Special Area of Conservation;
- National Parks;
- AONB; however the Kent Downs AONB surrounds the site to the north, east, and south.

2.5 Hydrogeology and Hydrology Constraints

The East Stour River traverses the north of the site and OS mapping indicates a network of drainage ditches. A number of discrete ponds are found across the site, the largest of which lies in the centre of the Folkestone Racecourse site.

The site is underlain by the Hythe Beds, which is designated a Principle Aquifer. The Atherfield and Weald Clays, which underlie the Hythe Beds and outcrop in the west of the site, are considered unproductive strata. The overlying Sandgate Beds, which outcrop in the centre-east of the site, are designated as a Secondary Aquifer and the Folkestone Beds, which outcrop in the far east of the site are a Principle Aquifer. The dominant bedrock underlying the site is the Hythe Beds, which comprise interbedded sandy-limestones and calcareous sandstone, which are both permeable and porous. Flow in the limestone would be dominated by fissure flow whereas the sandstone would allow intergranular flow. No comprehensive records have been found of groundwater elevations within the site.

3.0 Geology and Minerals

3.1 Regional Geology

The geology of the area around the site is recorded on the BGS 1:50 000 scale geological map number 305/306 and the associated memoir "Geology of the Country Around Canterbury and Folkestone" (1966). The bedrock forms the northern limb of the Weald anticline, a broad 'dome' structure stretching from Hampshire to Kent and onwards into northern France. This exposes the full thickness of the Cretaceous Strata in southern England. The beds within the area dip at a shallow angle (<5°) to the north-north east, with the strata at outcrop becoming younger as one moves to the north east.

The dip and variable properties of the strata have resulted in an undulating landscape formed from southerly facing escarpments and shallow northern slopes. The oldest strata which outcrop in the west of the region are the lower Cretaceous Wealdon Group Hastings Beds and Weald Clay. These are overlain to the north east by the Lower Greensand group, comprising in order of decreasing age; Atherfield Clay, Hythe Beds, Sandgate Beds, and Folkestone Beds. These are in turn overlain by the Gault Clay and Chalk.

South of the escarpment formed by the Weald and Lower Greensand groups, which runs westwards from Hythe, the surface geology is dominated by recent marine alluvium clay and sand.

North of the escarpment, the bedrock geology is locally overlain by superficial deposits including Pleistocene river terrace and head deposits, with modern alluvium along the routes of rivers.

3.1.1 Regional Minerals

Kent has a wealth of mineral deposits, including sand and gravel (derived from both superficial and bedrock deposits), crushed rock, brick clay, chalk and coal.

Sand and gravel is worked extensively around the county, from river terrace and sub-alluvial deposits along flood plains, storm beach gravels on the Dungeness peninsula, and from bedrock deposits within the Folkestone and Thanet beds (typically in the north of the county and around Maidstone).

Crushed rock production is confined to the chalk, which has historically been an important raw material for cement production although is limited in extraction at present, and the limestone layers within the Hythe beds, which are known as Kentish ragstone. The Ragstone quarrying industry has a long history, with production having occurred at a number of quarries in the county for supply of aggregates for construction of roads, concrete and for masonry. The industry is centred around Maidstone, where the properties of the beds are superior to the rest of the county and access to markets is easier, although historic workings are evident along the outcrop, including the aforementioned Otterpool quarry within the site.

Brick clays have been worked historically along the outcrops of many of the bedrock clay formation as well as the superficial Brickearth formations around Sittingbourne and Faversham.

Coal is no longer mined within Kent, having ceased in 1989 with the closure of Betteshanger Colliery. Medium to high quality coals were mined from Carboniferous strata of the south-easterly plunging syncline of the Kent Coalfield, which extends underneath the English Channel, and has been exploited at depths between 600m and 1500m.

3.2 Safeguarded Minerals

National planning policy requires that local planning authorities should seek to safeguard mineral deposits (and associated infrastructure sites) from sterilisation by other development to ensure a future supply of minerals. Mineral Safeguarding Areas (MSAs) are defined based on locations of deposits that are, or may in the future, be of sufficient economic value for extraction.

Kent County Council's (KCC) Minerals and Waste Local Plan (MWLP) (Adopted 2016) includes a series of maps showing the MSAs for each district within the county. Figure 2 includes an excerpt from the Shepway district MSA plan, in which the site lies. The geological mapping is derived from the BGS 1:50 000 scale digital mapping.

The Shepway district identifies MSAs for the following deposits in the area of the site:

- Sub-alluvial River Terrace
- Sandstone (Sandgate Formation)
- Limestone (Kentish Ragstone – Hythe Formation)
- Silica Sand / Construction Sand – (Folkestone Formation)

MSAs are defined simply on the basis of geological mapping and do not in this case consider existing constraints and sterilisation of deposits, mineral quality, thickness of deposit and viability of extraction.

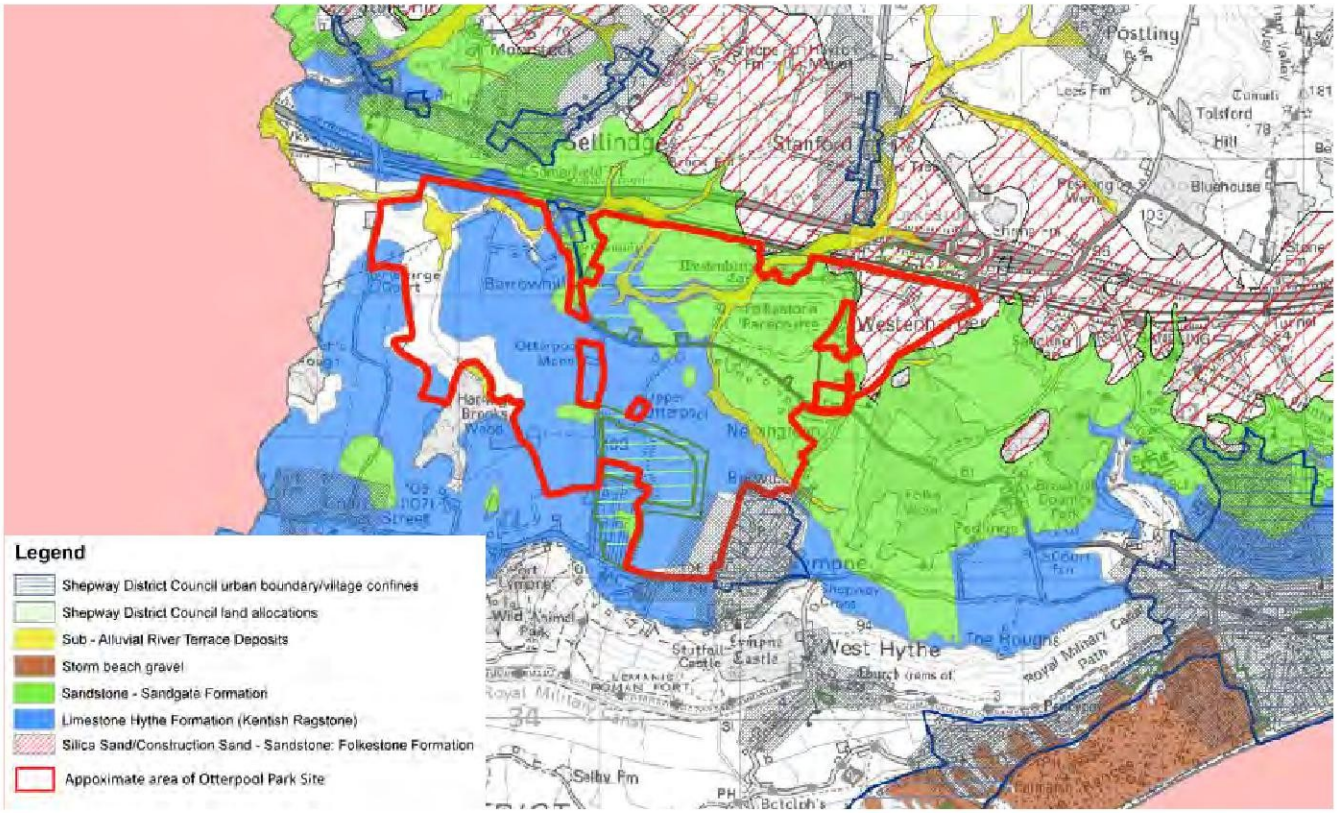

Figure 2 Excerpt from Shepway District Council MSA

3.3 Site Specific Geology

The bedrock and superficial geology of the site is shown in drawing numbers: 02 & 03 respectively.

The bedrock geology is comprised of strata of the Lower Greensand Group, with a localised outcrop of the underlying Weald Clay in the river valley to the west. There is general lack of publicly available borehole data covering the site from which to derive accurate measurements of the thickness of the various formations. Data provided by the client, including 5 no. rotary cored boreholes within the site, along with descriptions in the geological publications have been used to establish the stratigraphy and is set out in Table 1 below.

The geological map shows the Folkestone Formation outcropping in the eastern corner of the site, however BH105 (Arcadis) records Sandgate Formation beneath Head deposits at this location, suggesting some uncertainty in the accuracy of the mapping.

Superficial geology within the site consists of sub-alluvial river terrace and alluvium along the river valleys and head deposits.

Table 1
Geological Summary

Age	Formation	Lithology	Average Thickness (m)
Modern – Pleistocene	Sub-Alluvial River Terraces and Alluvium	Clay, silt, sand & gravel	0-5m
	Head Deposits	Various coloured, sandy gravels, silts, and clays – often derived from underlying bedrock	0-5m
Lower Cretaceous – Lower Greensand	Folkestone Formation	White or yellowish fine to medium sands with concretions of ironstone (ferruginous limestone and sandstone)	30-40m
	Sandgate Formation	Find sands, silts, & silty clays. Commonly glauconitic, some limonitic or calcareous. Some soft sandstones	~20m
	Hythe Formation	Buff coloured Interbedded sandy-limestones and glauconitic sandy mudstones and sandstones.	~10m in this locality
	Atherfield Formation	Blueish grey sandy clay	6-12m
Lower Cretaceous – Wealdon	Weald Clay	Brown and grey shaley clay	>60m

3.4 Site Specific Minerals

The following summary describes the safeguarded geological formations within the site as determined by the information available at the time of writing.

3.4.1 Sub-Alluvial River Terrace

Borehole and trial pit logs provided by Arcadis describe deposits of clayey sandy gravels in areas mapped as sub-alluvial river terrace. Particle Size distribution test results support this description, with recorded proportions of 36% gravel, 35% sand and 29% silt and clay (fines). Whilst this should not be considered representative of the entire deposits, these results indicate a deposit that would not be suitable for use as a construction aggregate, primarily due to the high fines content. Sands used for the manufacture of concrete

require fines contents of below 3%, and whilst washing of the sand during processing, such a high proportion of fines would not be viable for processing.

3.4.2 Folkestone Formation

No site investigation or test data exists for the Folkestone Formation in this locality, however the BritPits database includes records of sand extraction from the Folkestone Formation in nearby locations such as Sandling and Hyham Hill. On this basis it could be considered that the Folkestone Formation within the site has the potential to be of viable mineral quality. Sands quarried from the Folkestone Beds are predominantly washed and screened for use in mortar and ready mixed concrete and are referred to as 'soft sand'. Larger quarries in the Maidstone and Sevenoaks area produce value-added sand products, such as equestrian and horticultural sands, with additional processing. High-purity sand deposits exist within the Folkestone Formation, known as Silica Sands, and where proven are considered as an industrial mineral of national importance. The outcrop of Folkestone Formation within the site is relatively narrow compared to active areas of extraction around Maidstone and Sevenoaks, and site specific information for the thickness of the beds has not been provided or found, however, due to the dip of the beds and the position in the outcrop of the potentially viable areas, the thickness of the sand could be minimal. An average thickness of 5m has been used in this assessment.

3.4.3 Sandgate Formation

The Sandgate Formation is variously described as sand, silt, silty clay and sandstone. Borehole and trial pit logs provided by Arcadis support these descriptions, and particle size distribution tests fine sands with high fines contents (>30%). Small scale clay extraction is recorded in Westenhanger for brick and tile production, however beyond this there are no local recorded modern quarrying activities within the Sandgate Formation. In addition, the BGS 1:100 000 scale minerals map for Kent and the associated report, do not consider the Sandgate Formation to be a mineral bearing deposit. On this basis, it should be accepted that the Sandgate Formation has no potential for mineral extraction within the site.

3.4.4 Hythe Formation – Ragstone

The outcrop of the Hythe Formation in the locality of the site forms a broad area stretching WNW-ESE, with the beds dipping at a low angle (1-5°) to the north east. The beds outcrop at the surface over approximately two thirds of the site, in the central, southern and western areas, and continue down-dip beneath the Sandgate and Folkestone Formations to the north and east. Boreholes BH101 to BH104 (Arcadis) prove the Hythe Formation, although as no boreholes prove the entire thickness of the deposit an absolute thickness of the beds in this area cannot be determined. The BGS memoir describes the Hythe Formation at the outcrop in nearby Ashford as being 30ft (c.9m) thick, 40ft (c12m) at nearby Aldington, and ranging from between 60ft (18m) and <6ft (2m)within the district. As the beds dip to the north, the southern parts of the outcrop are likely to only consist of the lower part of the formation, as erosion will have remove the upper sections over time.

The Hythe Formation comprises alternating sequences of strong sandy limestone, known as Ragstone, and sandy mudstone or weak sandstone, known as Hassock. From a quarrying perspective, the Ragstone is targeted as a source of aggregate and building stone, whereas the Hassock is generally a waste 'interburden' or low grade fill or 'hoggin' (although records of use as a walling stone exist where the material is suitable). The relative proportions of Ragstone and Hassock vary across the Weald, with the outcrops around Maidstone, which have been extensively quarried, being the most thoroughly recorded. Individual beds of Ragstone and Hassock are not generally laterally continuous, and cannot therefore be relied upon for regional correlation, which is only achievable by identifying similar fossils within the beds. Information relating to quarries near Maidstone suggests Ragstone percentages of around 50%, although BGS reports suggest that the percentage can be as low as 20%. Ragstone beds typically vary between 0.15 and 1m thick, and are notably dense, having a specific gravity of 2.7.

Site specific mineral quality data has not been provided and no public domain data has been located to assess the specific nature of the ragstone beds within the site.

Otterpool Quarry is described as having exposure of the topmost section of the Hythe Formation in contact with the overlying Sandgate Formation and an unusually high concentration of fossils. It is for these reasons that the site is cited as a geological SSSI. The long running existence of the quarry and asphalt production suggests that the stone quality at this location is suitable for aggregate and specifically roadstone.

The use of ragstone as a building stone dates from the Roman period until the present day, and is extensive across south east England. A detailed description of the use of ragstone as a building material is provided in 'Kentish Ragstone' (Stocker, 2007).

Given the lack of site specific data on the distribution and nature of ragstone beds within the Hythe Formation, it is not possible to give an accurate assessment on the mineral quality and volume within the site, however, given the extensive regional quarrying and localised extraction at Otterpool, it is fair to assume that the Hythe Formation could be exploited as a source of crushed rock. Conservative parameters can be used to estimate the potential ragstone thickness and proportion for an outline resource estimate. In this report, an average thickness of 10m, and an average ragstone proportion of 30% has been used. As the site area is large, the resource estimates will be highly sensitive to these two factors, and thus any volumes estimated will be highly prospective.

4.0 Resource Assessment

4.1 Viability of Prior Extraction

4.1.1 Practicality of extraction

In order to define and quantify a mineral resource, consideration should be given to the potential environmental impacts of the extraction of the mineral resource and the application of suitable buffer zones, or 'stand-offs', to maintain adequate distance between the operation and the potential receptor.

Buffer zones will depend upon the nature of the operation and the receptor, the potential pathway for the impact, and thus will vary on a site-by-site basis. Kent County Council's Minerals Local Plan does not specify typical buffer zones for mineral types, so experience of existing operations and other policy areas has been used. The following buffer zones have been applied to this assessment to reflect the environmental and economic viability of the mineral resource:

- Residential Dwelling: 100m
- Public Road: 10m

The method of extraction for different mineral resources will vary depending on the properties of the mineral resource and the environment around the extraction area (for example the ground water elevation). For the two mineral resources identified within the site, the following extraction methods would be typical.

- Folkestone Formation – when worked dry: extracted by excavator in quarries with sloping side profile formed at around 45° or shallower. When worked wet due to high ground water; either by suction dredger or barge-mounted excavator forming a lake with shallow side slopes at around 18°
- Hythe Formation – extracted by drilling and blasting forming steep sided (c.70°) slopes 10 - 15m high with intervening benches (berms).

Overburden formed from either soils or unsaleable superficial and bedrock strata will typically be 'stripped' to uncover the mineral deposits and stored in heaps around or adjacent to the excavation for later use in site restoration.

Restoration of excavation sites will vary on a site specific basis, and can consist of open water bodies, nature reserves, or they can be returned to their original ground level through the importation of other material such as waste products.

Ragstone extraction would potentially result in areas of deep, steep sided excavations which would not be suitable for subsequent redevelopment without importation of significant amounts of materials to restore the excavation. Risks of flooding and ground instability would need to be considered.

4.1.2 Use within the Development

Whilst the detailed design of the development is not yet finalised, it is likely that there will be a requirement for areas of cut and fill to create developable sites. Use of minerals released through incidental extraction could be considered should the materials be of suitable quality. Such uses could be as a component in ready mixed concrete, general fill, or in the case where suitable beds of Ragstone are found, as masonry elements or landscape features. The use of vernacular stone such as this could add distinctive aesthetic elements to the development. It is not possible at this stage to ascertain areas where incidental extraction could occur, and further investigation would be required to determine the properties of the materials to be extracted and their potential uses.

4.1.3 Potential Design Criteria

In order to attempt to quantify the mineral resource, the estimates have been based on calculating the surface area of mineral deposits presently unconstrained by buffer zones, multiplied by average thicknesses and recovery percentages. Areas for calculating ragstone volumes have been established based on geometries that could be achieved with the required extraction methods.

4.1.4 Value of the mineral resource

Construction aggregates, for use in concrete, asphalt, mortar, or as low value fill material, are considered as low 'place-value' products. Their low value and high cost of transport is such that the distance to market is critical in defining market values and viability of production sites. It is not possible to estimate the specific value of a construction mineral resource on a general basis, as many operational factors such as processing costs, overburden ratios, water management, as well typically high capital costs for items such as land acquisition, planning and permits, and plant and infrastructure are bound up in the cost of producing the mineral. Different products (i.e. rock types, sizes) will have different market values determined by their end uses, and factors of supply and demand. Certain materials may be sold 'at cost' in order to access more valuable materials within a site.

In general, aggregate products are only cost effective if transported over relatively short distances, and thus in order to make extraction viable, there must be a source of demand near-by. In the case of this site, the towns of Folkestone and Ashford would form the predominant markets for materials extracted in this area, with higher value materials travelling further afield.

The nature of the road network must also be considered. In the case of this site, the proximity to the A20 and M20 roads allow for good access to market, although the initial journeys would require haulage along narrow countryside roads and through villages.

Extraction and processing of the mineral deposits requires significant up-front investments in processing plant to produce saleable products from the raw materials. Such large investments require a suitably large mineral reserve to justify the life of the investment, with many of the existing quarry sites (such as those around Maidstone and Sevenoaks) having been in operation for many years.

The scarcity of the mineral should also be considered in the relative value of a deposit. As discussed above, the mineral deposits outcropping within the site are formed from extensive bedrock strata that also outcrop outside of the site, both within the Shepway District and across Kent as a whole. Whilst no specific quality data has been found in relation to the deposits within the site, references within geological literature, and the general lack of a modern quarrying industry within the district suggest that the deposits found here are not of optimum quality when compared to the well-established quarrying areas to the North West.

4.2 Results

Potential tonnages of presently unsterilised mineral deposits that could be sterilised by the proposed development are shown in Table 2 below:

Table 2
Summary of Tonnages

Mineral	Area	Tonnage
Hythe Fm. with superficial overburden	1,583,000m²	12,820,000 t
Hythe Fm. with Sandgate Fm. & superficial overburden	811,000m²	6,569,000 t
Total Hythe Fm	2,122,000 m²	17,186,000 t
Folkestone Fm	185,000m²	1,108,000 t

4.2.1 Assumptions

The following assumptions on mineral depth and quality have been used in the above estimates:

- Hythe Formation
  - Thickness: 10m
  - Recovery: 30% (proportion of deposit comprising workable Ragstone)
  - Density: 2.7t/m³
- Folkestone Formation
  - Thickness: 5m
  - Recovery: 75% (saleable product following processing)
  - Density: 1.6t/m³

5.0 Planning Context

Otterpool Park is being promoted as a garden town which is planned and supported by Folkestone and Hythe District Council to help meet the current and future housing need for the Folkestone and Hythe area.

As indicated above, the potential mineral resource for the site is estimated to be some 18 million tonnes of mineral which represents that which would be directly sterilised by any built development within the site.

5.1 National Planning Policy

National Planning Policy Framework, 2018

The NPPF (2019) sets out the Government's planning policies for England and how these are expected to be applied. The presumption in favour of sustainable development sits at the heart of the NPPF, and this requires that local planning authorities should positively seek opportunities to meet the development needs of their area, and that local plans should meet objectively assessed needs, with sufficient flexibility to adapt to rapid change. The NPPF also states that development proposals that accord with an up-to-date development plan should be approved without delay (paragraph 11c).

Section 17 of the NPPF sets out the requirements for planning policy to facilitate the sustainable use of minerals, including the requirement to safeguard minerals from sterilisation by non-mineral development (paragraph 204c).

5.1.1 Landbanks

A 'landbank' is a stock of planning permissions for the winning and working of minerals into the future. The size of a landbank is measured in terms of a number of years and is calculated by working out:

- The total capacity (in tonnes) of all permitted mineral reserves with planning permission, and then,
- Dividing this total capacity by the annual rate of mineral supply provision (in tonnes per year) proposed in this Plan for the plan-period, and then,
- Expressing this calculated figure in terms of years' equivalent (e.g., the landbank is 8.4 years).

The NPPF states that minerals planning authorities should plan for a steady and adequate supply of aggregates (paragraph 207) and industrial minerals (paragraph 208) by, amongst others:

- Encouraging safeguarding or stockpiling so that important minerals remain available for use.
- Making provision for the maintenance of landbanks of at least ten years for crushed rock.

5.2 Adopted Kent Minerals and Waste Local Plan 2013-30 (KMWLP), 2016

At the heart of the NPPF is a presumption in favour of sustainable development. The NPPF requires that policies in local plans should follow the approach of the presumption in favour of sustainable development. The KMWLP is therefore based on the principle of sustainable development and this is reflected in the Spatial Vision and the Strategic Objectives, and the policies that seek sustainable solutions.

The strategic objectives set out in the KMWLP are underpinned by an ambition to manage mineral extraction and supply according to the principles of sustainable development and as far as mineral extraction is concerned some of those general main minerals strategic objectives are set out below:

5.2.1 General

1. Encourage the use of sustainable modes of transport for moving minerals and waste long distances and minimise road miles.
2. Ensure minerals and waste developments contribute towards the minimisation of, and adaptation to, the effects of climate change. This includes helping to shape places to secure radical reductions in greenhouse gas emissions and supporting the delivery of renewable and low carbon energy and associated infrastructure.
3. Ensure minerals and waste sites are sensitive to both their surrounding environment and communities, and minimise their impact on them.
4. Enable minerals and waste developments to contribute to the social and economic fabric of their communities through employment opportunities.

5.2.2 Minerals

5. Seek to ensure the delivery of adequate and steady supplies of sand and gravel, chalk, brickearth, clay, silica sand, crushed rock, building stone and minerals for cement during the plan period, through identifying sufficient sites and safeguarding mineral bearing land for future generations.
6. Promote and encourage the use of recycled and secondary aggregates in place of land-won minerals.
7. Safeguard existing, planned and potential sites for mineral infrastructure including wharves and rail depots across Kent to enable the on-going transportation of marine dredged aggregates, crushed rock and other minerals as well as other production facilities.
8. Enable the small-scale, low-intensity extraction of building stone minerals for heritage building products.
9. Restore minerals sites to the highest possible standard to sustainable after uses that benefit the Kent community economically, socially or environmentally. Where possible, after uses should conserve and improve local landscape character and incorporate opportunities for biodiversity to meet targets outlined in the Kent Biodiversity Action Plan, the Biodiversity Opportunity Areas and the Greater Thames Nature Improvement Area.
10. Encourage the sustainable use of the inert non-recyclable fraction of Construction, Demolition and Excavation Waste for quarry restoration.

The stock of planning permissions for crushed rock (ragstone) in Kent at the time of plan preparation are sufficient to maintain a landbank of ten years supply (assumed as 0.78mtpa) throughout and beyond the end of the plan period and so no additional crushed rock (ragstone) sites are identified in the Minerals Sites Plan.

At the time of plan preparation, consented reserves of crushed rock are contained within two Kentish Ragstone sites (Hermitage Quarry and Blaise Quarry). The latter contains the bulk of the permitted reserves that are generally of low quality and so their use is limited and mineral extraction only takes place from this site intermittently on a campaign basis. In view of this, a policy covering situations where non-identified land-won mineral sites could be acceptable is included as Policy CSM 4. Such conditions include;

- Prior extraction ahead of development where minerals are safeguarded,

- Borrow pits for infrastructure developments
- Matters such as the location, quality, and constraints on extraction of permitted reserves which might limit output over the plan period.

The KMWLP provides for crushed rock for the Plan period plus a landbank of 7.28mt in 2030 without the need for any new allocation[2].

5.2.3 Policy DM 7 - Safeguarding Mineral Resources

The site is not allocated as a Preferred or Reserve site in the adopted Kent Minerals and Waste Local Plan 2016 but as indicated in section 1.0 above is located within a Minerals Safeguarding Area.

Therefore, consideration must be given under policy DM7 and DM9 of the KMWLP to whether the mineral could be subject to prior extraction, and economic and environmental viability of extraction.

Policy DM 7 of the Plan states:

Planning permission will only be granted for non-mineral development that is incompatible with minerals safeguarding, where it is demonstrated that either:

1. *The mineral is not of economic value or does not exist; or*
2. *That extraction of the mineral would not be viable or practicable; or*
3. *The mineral can be extracted satisfactorily, having regard to Policy DM9, prior to the non-minerals development taking place without adversely affecting the viability or deliverability of the non-minerals development; or*
4. *The incompatible development is of a temporary nature that can be completed and the site returned to a condition that does not prevent mineral extraction within the timescale that the mineral is likely to be needed; or*
5. *Material considerations indicate that the need for the development overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted following the exploration of opportunities for prior extraction; or*
6. *It constitutes development that is exempt from mineral safeguarding policy, namely householder applications, infill development of a minor nature in existing built up areas, advertisement applications, reserved matters applications, minor extensions and changes of use of buildings, minor works, nonmaterial amendments to current planning permissions; or*
7. *It constitutes development on a site allocated in the adopted development plan*

Further guidance on the application of this policy will be included in a Supplementary Planning Document.

5.2.4 Policy DM9 - Prior Extraction of Minerals in Advance of Surface Development

Policy DM 9 of the Plan states that:

Planning permission for, or incorporating, mineral extraction in advance of development will be granted where the resources would otherwise be permanently sterilised provided that:

1. *the mineral extraction operations are only for a temporary period; and,*
2. *the proposal will not cause unacceptable adverse impacts to the environment or communities*

Where planning permission is granted for the prior extraction of minerals, conditions will be imposed to ensure that the site can be adequately restored to a satisfactory after-use should the main development be delayed or not implemented.

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[2] Paragraph 5.2.25

5.3 Early partial review of the Kent Minerals and Waste Local Plan, 2018

Consultation of the early partial review of the Kent Minerals and Waste Local Plan took place in March 2018. As part of this the County Council sought to improve the clarity of the policies relating to minerals and waste safeguarding to improve their effectiveness when used in practice. With regards to DM7 (Safeguarding Mineral resources) the revised wording of the policy seeks to re-word Criteria 7 ("it constitutes development on a site allocated in the adopted development plan") to the following: "7. it constitutes development on a site allocated in the adopted development plan where consideration of the above factors (1-6) concluded that mineral resources will not be needlessly sterilised". The emerging policy position therefore seeks to ensure where economic minerals are identified in a MSA whose extent coincide with allocations for non-mineral development that would have a potentially sterilising effect on these mineral resources, then a full assessment that meets the other criteria 1 to 6 (where appropriate) (as set out at Policy DM7) of the policy should be done, to the satisfaction of the Mineral Planning Authority (MPA).

KCC plan to present this emerging plan to full Council in late 2018 with a view to publishing for public consultation early 2019. KCC are targeting a summer 2019 examination and adoption before the end of 2019.

5.4 Emerging Minerals Sites Plan

KCC's Minerals Sites Plan - Options Consultation (September 2017) identifies potential minerals sites for allocation within the reviewed local plan. With respect to potential minerals within the Otterpool Park site, the document states a shortfall of 1.992Mt of soft sand for construction aggregates (Folkestone Formation) over the plan period plus 7 years (to maintain the landbank at the end of the plan period). Two sites have been proposed which could provide over 7Mt of reserves in the districts of Maidstone and Tonbridge and Malling. The document does not identify any potential sites for crushed rock (i.e. Hythe Formation) and states that the landbank is sufficient for Plan purposes.

The sites proposed in the Emerging Mineral Sites Plan do not impact on the area of the proposed Otterpool Park development.

5.5 Policy Tests in Relation to the Proposed Development

Section 5.2.3 above states the requirements of policy DM7 in considering developments that are incompatible with mineral safeguarding. The following section sets out the policy tests in relation to the minerals within the site.

5.5.1 The mineral deposit is not of economic value or does not exist

Based on current geological knowledge, derived from BGS geological mapping and desk-based studies undertaking for this report, it is understood that the Hythe and Folkestone Formations exist within the site, in areas currently unsterilised by existing restrictions, which could yield crushed rock and soft sand resources respectively.

Hythe Formation

The economic value of the resources should be considered in light of the mineral supply, reserves and resources that exist within the county. In the context of this report, mineral reserves applies to deposits with permission for extraction (i.e. existing quarries), and resources applies to the remaining outcrop of the mineral bearing formations. Mineral reserves of crushed rock within Kent are confidential, due to the limited number of active sites, namely Hermitage Quarry (Maidstone) and Blaise Farm Quarry (West Malling). Both quarries

are currently active, and reserves are estimated as some 46.44 million tonnes[3]. These reserves are able to be worked using existing plant and infrastructure at long established sites. Annual extraction is assumed to be 0.78 Mtpa, and the total estimated reserve provides approximately 60 years of reserves. In addition, hard rock minerals are imported via rail and sea at a rate of approximately 1.5 Mtpa[4] and supplied to the market from a network of railheads and wharves around the county. In particular, two railheads exist near Ashford, which provide for the importation of high quality crushed rock aggregates, such as granite and carboniferous limestone into the local area. It can therefore be assumed that current and foreseeable future hard rock aggregate supply requirement can be met by existing sites and imports. Increases in demand could be met by increasing capacity at import terminals and existing quarries, without the significant costs and impacts that would occur in opening a new extractive site.

Development of a large new hard rock quarrying operation, as would be required by the extraction of the Ragstone resource at Otterpool Park in the timescale of the proposed development, would have a significant negative impact on the aggregate prices and economic viability of the existing sites as well as any new proposed site.

In terms of the wider resources of Kentish Ragstone, the outcrop area of Hythe Formation in Kent covers approximately 200 million m², of which the Otterpool Park outcrop comprises less than 1%. It is also suggested by the research that the deposits of Ragstone in the area south east of Ashford are of lower quality than those found in the north of the county (where the active quarries operate).

Folkestone Formation

Soft sand reserves within Kent are reported as 8.85 Mt, providing a landbank of some 17.6 years based on 3-year average sales with eight active and two inactive quarries[5]. The current rates of extraction are estimated as representing 58% of the current capacity for production and sales within the county, suggesting that potential increases in demand could be met by existing supply and increases in capacity.

New potential soft sand sites to satisfy the requirement of the current and emerging local plans will be provided for from other areas within the county, with two proposed sites recorded in the Local Aggregates Assessment as totalling some 7 million tonnes. The potential outcrop of the Folkestone Formation is very large, and a number of sites extract soft sand resources following removal of significant quantities of overburden that overly the mineral deposits, further increasing the workable area. The resource of unsterilised Folkestone Formation in the site likely represents a minute fraction of the total resource within Kent and the surrounding counties.

The economic value of the soft sand resource in Otterpool Park should be considered as very low given the lack of demand (indicated by spare capacity at other sites) and the availability of resources at larger sites elsewhere in the county.

5.5.2 That extraction of the mineral would not be viable or practicable

A detailed assessment of the geotechnical, hydrogeological, and environmental aspects of extraction is outside of the scope of this assessment, however in general terms, the physical extraction of mineral deposits could be considered as potentially practicable given the existence of quarries elsewhere in the county. The economic viability of extraction however has been addressed in section 5.5.1 above, and in terms of the potential mineral deposits within the site, it can be considered that extraction would not be economically viable.

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[3] Kent County Council, Draft Local Aggregate Assessment, November 2018
[4] Ibid.
[5] Ibid.

5.5.3 The mineral can be extracted satisfactorily, having regard to Policy DM9, prior to the non-minerals development taking place without adversely affecting the viability or deliverability of the non-minerals development

Section 5.6 below provides further detail on the viability of prior extraction. The likely rates of extraction would be low given the current supply and demand profile within Kent, and the resultant landform following mineral extraction would adversely affect the deliverability of the proposed development.

5.5.4 The incompatible development is of a temporary nature that can be completed and the site returned to a condition that does not prevent mineral extraction within the timescale that the mineral is likely to be needed

The proposed development is not temporary in nature; therefore this test is not applicable in this case.

5.5.5 Material considerations indicate that the need for the development overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted following the exploration of opportunities for prior extraction

The proposed development and the potential sterilisation of minerals should be considered in the light of the need for housing, other alternatives, and the scarcity of the mineral deposits. Information presented in previous sections of this report shows the relative lack of scarcity of available mineral resources (i.e. the large outcrop of the Hythe and Folkestone Formations) and the current and future reserves / landbanks which are able to meet demand.

The current steady supply and the ease of increasing supply of imported crushed rock and marine sand and gravel are a distinct contrast to the potential environmental impacts of the prior extraction of the potentially sterilised mineral resources.

5.5.6 It constitutes development that is exempt from mineral safeguarding policy,...

The proposal does not constitute exempt development, therefore this test is not applicable in this case. Exempt developments comprise: householder applications, infill development of a minor nature in existing built up areas, advertisement applications, reserved matters applications, minor extensions and changes of use of buildings, minor works, and nonmaterial amendments to current planning permissions.

5.5.7 It constitutes development on a site allocated in the adopted development plan

The proposed development has a draft site allocation in the emerging Core Strategy Review.

5.6 Viability of Prior Extraction

With consideration to the requirement 3 of policy DM7 and requirement 2 of policy DM9, prior extraction of the mineral resource should be incorporated into the development if "the proposal will not cause unacceptable adverse impacts to the environment or communities". Extraction of the mineral resource would require an Environmental Impact Assessment (EIA) to determine the potential adverse impacts. The nature of extractive operations as discussed in section 4.1 are such that impacts to be considered could include:

- adverse effects on the local amenity of existing residents as a result of, amongst other matters, blasting activity, noise, dust and traffic impacts and are likely to result in opposition from local residents in the area.
- negative impacts on the environment which would require assessment and mitigation, including impacts on hydrogeology, hydrology, and biodiversity.

- Prior extraction at the site would result in the restored landform being at a lower level than the surrounding topography and the creation of a void would result in long term negative visual impacts on the landscape.
- Retention of a quarry void could, depending on the depth of the excavation and the elevation of the water table, result in the creation of an open water body and the potential loss of developable land.

The extraction of aggregate is a high cost exercise, requiring significant 'up-front' investment from an operator associated with securing the rights to the land and subsurface, obtaining the relevant planning permissions and permits to operate and backfill the site (where necessary). In addition, costs for the purchasing of the necessary processing and mobile plant along with transportation of material would be costly.

The costs associated with obtaining permission and the relevant permits to allow extraction of a deposit are such that in each case, a threshold value of the deposit must be achieved to offset the initial costs.

Given the high capital costs for extraction and processing plant, prior extraction could be viable if the mineral could be transported to an existing or similar quarry for processing. However, the distance to existing sites (predominantly near to Maidstone) of around 35 miles is such that this is unlikely to be cost effective. However, in such a case, further testing would be required to ensure that the quality of the mineral is suitable for the production of aggregates through that particular processing plant.

Extraction and processing is often market led, in that the material is generally extracted and processed to order, as opposed to rapidly dug and stockpiled for later consumption. In the absence of a defined market beyond the local open market for aggregates which is served by existing operations, it would be difficult to extract and stockpile the volume of mineral available without substantially prejudicing the ability to implement the proposed Otterpool Park scheme. Any 'compromise' extraction scheme which seeks to exploit a proportion of the mineral would be faced with a similar (albeit a proportionally reduced problem), but where the benefits of such limited prior extraction then recede.

The variable nature and high wastage ('hassock') content of the Hythe Formation requires that an additional market for low grade fill would be required in order to extract the potentially marketable ragstone deposit.

The duration of the operations to extract the mineral deposits would be defined by the market demand as large scale stockpiling of materials and would not be viable. Rates of extraction would also be influenced by environmental impacts, such as traffic and hours of operation, however if production rates of 300ktpa and 100ktpa for crushed rock and soft respectively, the potential resources of ragstone could require 57 years to extract and the soft sand could require 11 years.

In addition, the increased regional production of aggregates that would occur if prior extraction and supply in to the local market could serve to depress aggregate prices and further reduce the financial viability of the mineral resource.

Use of suitable incidental minerals (i.e. site won during development) could be incorporated to the development scheme, the design of which is beyond the scope of this report.

5.7 Summary

The land at Otterpool Park site benefits from a proposed allocation in the emerging Folkestone and Hythe Core Strategy Review.

An assessment of the available information relating to the geology of the site has identified a potential mineral resource comprising Hythe Formation (ragstone) and Folkestone Formation (soft sand) which are safeguarded minerals under the Kent County Council Minerals and Waste Local Plan. The quality of the mineral deposits, in relation to their use in construction materials is presently unknown, as specific site investigation of the minerals has not been undertaken. Assumptions based on quarry operations in similar deposits and regional geological information have been used.

The investment required to purchase or hire an aggregate processing plant, the associated infrastructure costs, and, when assessed against policy DM9 of the KMWLP, the environmental impacts in terms of noise, traffic movements etc., also serve to make minerals development for a small resource in a residential location both unviable and likely to cause an unacceptable adverse impact to the environment and local amenity.

The process of obtaining planning and the necessary permits could mean a significant delay in meeting the objectives of the Otterpool Park New Town project which is not consistent with the spirit of the NPPF

Whilst some limited mineral reserves exist at the site, the timescales over which extraction would take place, alongside the possible impacts associated with it, would be likely to attract local objections on the grounds of amenity and environmental impacts. In addition, having regard to policy DM7 of the KMWLP it is not considered practicable to work this site in that it would adversely affect the deliverability of Otterpool Park.

According to the KCC Draft Local Aggregates Assessment (November, 2018), there is no additional demand for the minerals that would allow the prior extraction of minerals in a manner that would not adversely affect the deliverability of the proposed development.

Prior extraction, whilst technically viable should be weighed against the impacts of extraction on the environment and local amenity and the need for the District Council to deliver their strategic housing allocations for the development plan period. It is therefore considered that prior extraction would prejudice the delivery of the high quality mixed-use development on an important development site and would conflict with the NPPF which seeks to approve development which accords with development plan policy 'without delay'.

It is unlikely that prior extraction would be economically viable on the basis of the negative impact on existing aggregate markets reducing aggregate prices, and the high cost of extraction and value added processing of aggregates.

6.0 Conclusions

A Mineral Resource Assessment has been carried out for the proposed Otterpool Park development. Data sources obtained from the public domain and provided by the client have been consulted to produce a conceptual geological model for the area.

Kent County Council Mineral Safeguarding Areas exist within the site for four deposits. Two of the deposits are of insufficient extent or quality to classify as viable mineral deposits; namely the Sandgate Formation, and sub-alluvial river terrace. The safeguarded Hythe Formation (containing Kentish Ragstone) and Folkestone Formation (soft sand) occur within the site across sufficient areas to consider as *potentially* viable mineral deposits. Data on the thickness and quality of the minerals is not available for this location, so assumptions based on similar areas and geological literature have been made to assess the potential viability of the minerals.

Based on the information consulted and the assumptions made, the estimated tonnages of presently unsterilised minerals within the development site are c.1.1Mt of Folkestone Formation and c.17.2Mt of Hythe Formation.

Hythe Formation – Kentish Ragstone

The stock of planning permissions for crushed rock (ragstone) in Kent at the time of plan preparation are sufficient to maintain a landbank of ten years supply (assumed as 0.78mtpa) throughout and beyond the end of the plan period and so no additional crushed rock (ragstone) sites will be identified in the Emerging Minerals Sites Plan.

At the time of plan preparation, consented reserves of crushed rock are contained within two Kentish Ragstone sites. One of which contains the bulk of the permitted reserves that are generally of low quality and so their use is limited. In view of this, a policy covering situations where non-identified land-won mineral sites could be acceptable is included as Policy CSM 4.

Local historic market conditions have been such that the ragstone quarry in Otterpool became unviable and extraction ceased during the mid-2000's. No further interest in the resumption of quarrying activities has been published, suggesting that the site is not viable under current conditions.

Higher quality deposits of Hythe Formation ragstone, with lower proportions of waste sand 'hassock' are more extensive around Maidstone, where current and historic quarrying operations are located.

Substitution of primary crushed rock with recycled materials, such as granite rail ballast, is undertaken within the local market and provides a long term sustainable source of high quality materials with significantly reduced environmental impacts.

Folkestone Formation – Soft Sand

The landbank of soft sand within Kent is such that two new sites have been proposed in the Emerging Minerals Sites Plan, which if developed would satisfy the landbank requirements for the plan period and beyond.

The relatively small area of Folkestone Formation outcrop in the east of the site is such that a mineral resource of viable scale to warrant the cost of development is unlikely to be present.

Large scale prior extraction of the minerals is incompatible with the proposed development, due to the resultant excavations created by extraction of bedrock materials.

The lack of local and regional demand over and above that satisfied by existing operations is such that development of a new large extraction operation would not have a sufficient local market to be economically viable within the timescales appropriate to prior extraction.

It is therefore the conclusion of this report that mineral extraction is not viable and the development should be exempted from the safeguarding criteria.

Use of materials derived through incidental extraction during the development could be considered, subject to confirmation of their properties to reduce the demand for importation of construction aggregates from off-site sources. Further ground investigation would be required to assess the potential for incidental use, and could be considered during the detailed design stages of the proposed development where excavations for civil engineering purposes may be required..

The use of Kentish Ragstone as a visible element of the development (such as building facing or landscaped areas) could be considered as a suitable use of site-won materials in promoting the geodiversity and heritage of the region.

DRAWINGS

608500E 609000E 609500E 610000E 610500E 611000E 611500E 612000E 612500E 613000E 613500E 614000E 614500E

138500N 138000N 137500N 137000N 136500N 136000N 135500N 135000N 134500N 134000N 133500N

Moorstock
Sellindge
Barrowhill
Westenhanger
Newingreen
Court-at-Street
Lympne
Pedlinge
West Hythe
Sandling

WESTONHANGER CASTLE

OTTERPOOL QUARRY

Legend

- Site_Boundary
- Listed Buildings
- Scheduled Ancient Monument
- Ancient Woodland
- SSSI
- AONB

Flood Risk

- High
- Medium
- Low
- Very Low

N

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OTTERPOOL PARK
MINERAL RESOURCE ASSESSMENT

Location Plan

SLR Project Ref: 416.01645.00004
Drawing No: 01
Scale: 1:20,000 (A3)
Date: AUGUST 2018

609000E 609500E 610000E 610500E 611000E 611500E 612000E 612500E 613000E 613500E

138000N 137500N 137000N 136500N 136000N 135500N 135000N 134500N

Sellindge
Barrowhill
Stanford
Westenhanger
Newingreen
Lympne
Court-at-Street
West Hythe
Royal Military Canal
East Stour River

TP101 BH102 TP102 TP103 BH105 TP104 TP105 TP106 TP107 TP108 TP109 TP110 TP111A TP111B TP112 TP113
HD101 HD102 HD103
WS102 WS103 WS104B WS104C WS105 WS106 WS107 WS108 WS109 WS110 WS111 WS112
BH101 BH103 BH104

Legend

- Site_Boundary
- Arcadis Site Investigation
- Rotary Borehole
- Hand Dug Pit
- Trial Pit
- Window Sample

BGS GEOLOGY - BEDROCK

- GAULT FORMATION
- FOLKESTONE FORMATION
- SANDGATE FORMATION
- HYTHE FORMATION
- ATHERFIELD CLAY FORMATION
- WEALD CLAY FORMATION

N

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OTTERPOOL PARK MINERAL RESOURCE ASSESSMENT

BEDROCK GEOLOGY

SLR Project Ref: 416.01645.00004
Drawing No: 02
Scale: 1:15,000 (A3)
Date: SEPTEMBER 2018

609000E 609500E 610000E 610500E 611000E 611500E 612000E 612500E 613000E 613500E

138000N 137500N 137000N 136500N 136000N 135500N 135000N 134500N

Sellindge
Barrowhill
Stanford
Westenhanger
Hillhurst Farm
Newingreen
Lympne
Court-at-Street
West Hythe
The Roughs
Royal Military Canal

TP101
BH102
TP102
TP105
WS108
WS110
WS107
BH105
TP103
HD101
HD102
HD103
TP104
WS105
WS106
BH103
WS104B
WS104C
TP113
TP107
TP108
TP106
WS111
WS109
TP109
TP111B
TP111A
WS103
WS112
WS102
BH101
TP110
TP112
BH104

Legend

- Site_Boundary
- Arcadis Site Investigation
- Rotary Borehole
- Hand Dug Pit
- Trial Pit
- Window Sample

BGS GEOLOGY - SUPERFICIAL

- HEAD DEPOSITS
- PEAT
- ALLUVIUM

N

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OTTERPOOL PARK
MINERAL RESOURCE ASSESSMENT

SUPERFICIAL GEOLOGY

SLR Project Ref: 416.01645.00004
Drawing No: 03
Scale: 1:15,000 (A3)
Date: SEPTEMBER 2018

609000E 609500E 610000E 610500E 611000E 611500E 612000E 612500E 613000E 613500E

138000N 137500N 137000N 136500N 136000N 135500N 135000N 134500N

HYTHE FM BENEATH SANDGATE FM

FOLKESTONE FORMATION

HYTHE FM AT OUTCROP

Selindge
Barrow Hill
Stanford
Westenhanger
Newingreen
Lympne
Court-at-Street
West Hythe
Royal Military Canal
East Stour River

Legend

- Site_Boundary
- Area of Unconstrianed Potential Mineral

BGS GEOLOGY - BEDROCK

- GAULT FORMATION
- FOLKESTONE FORMATION
- SANDGATE FORMATION
- HYTHE FORMATION
- ATHERFIELD CLAY FORMATION
- WEALD CLAY FORMATION

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OTTERPOOL PARK MINERAL RESOURCE ASSESSMENT

MINERAL AREAS

SLR Project Ref: 416.01645.00004

Drawing No: 04

Scale: 1:15,000 (A3)

Date: SEPTEMBER 2018

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